Claims

What is claimed is:

1. A yarn carrier for winding yarn thereon comprising:
   a. a hollow cylindrical tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof and having a substantially cylindrical outer surface, the tube having a recess formed into the first end of the tube, the recess having an inside surface with first and second ends, and a first recess side surface extending from the first end of the inside surface to the first end of the tube; and
   b. a yarn catch insert adapted to be inserted into the recess, the yarn catch insert having an inside surface with first and second ends, an outside surface, and a first side surface extending between the first end of the inside surface and an outside surface, wherein when the yarn catch insert is inserted into the recess, the inside surface of the yarn catch insert is positioned opposite the inside surface of the recess and a distance between the inside surface of the recess and the inside surface of the yarn catch insert tapers along at least a portion of the inside surface of the recess.
2. The yarn catch insert according to claim 1 wherein the distance between the inside surface of the recess and the inside surface of the yarn catch insert tapers to a pinch point.
3. The yarn carrier according to claim 1 wherein the distance between the inside surface of the recess and the inside surface of the yarn catch insert tapers in a direction from the first end to the second end of the inside surface of the recess along a portion of the inside surface of the recess and widens in the same direction along a different portion of the inside surface of the recess.
4. The yarn carrier according to claim 1 wherein a score is formed in the outer surface of the tube, the score extending circumferentially around the tube and intersecting the inside surface of the recess.
5. The yarn carrier according to claim 1 wherein the inside surface of the recess

and the inside surface of the yarn catch insert are substantially perpendicular to the longitudinal axis of the tube.

6. The yarn carrier according to claim 1 wherein the yarn catch insert comprises a shelf that is positioned radially inward of and extending under the outer surface of the tube when the yarn catch insert is inserted in the recess and the tube includes a channel formed in the first recess side surface adapted to receive the shelf of the yarn catch insert to prevent the yarn catch insert from extending radially outward of the outer surface of the tube.

7. The yarn carrier according to claim 1 wherein at least one of the first recess side surface and the first side surface of the yarn catch insert includes teeth for removably securing the yarn catch insert in the recess.

8. The yarn carrier according to claim 1 wherein the yarn catch insert flexibly extends from the tube whereby the inside surface of the yarn catch insert may be removably inserted into the recess.

9. The yarn carrier according to claim 8 further comprising a void at the second end of inside surface of the recess.

10. The yarn carrier according to claim 8 further comprising a void formed in the outside surface of the yarn catch insert to facilitate rotation of the yarn catch insert into the recess.

11. The yarn carrier according to claim 8 further comprising teeth formed on at least one of the first recess side surface and the first side surface of the yarn catch insert for removably securing the yarn catch insert in the recess.

12. A yarn catch insert for insertion into a hole formed through a yarn winding tube, the yarn winding tube being a hollow cylindrical tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof and having a substantially cylindrical outer surface, the hole having a side surface with a portion extending circumferentially around a portion of the circumference of the tube, the yarn catch insert having an inside surface, an outside surface, and a side surface, a portion of the side surface positioned opposite the portion of the side

surface of the hole when the insert is inserted into the hole to form a start-up groove between the portion of the side surface of the yarn catch insert and the portion of the side surface of the hole, at least a portion of the start-up groove tapered in a direction along a circumference of the tube.

13. The yarn catch insert according to claim 12 wherein the yarn catch insert has a flange adjacent to its inside surface for preventing the outside surface of the yarn catch insert from extending beyond the outside surface of the tube.

14. The yarn catch insert according to claim 12 wherein an edge between the outside surface of the yarn catch insert and the portion of its side surface is radiused.

15. The yarn catch insert according to claim 12 wherein the start-up groove tapers to a pinch point.

16. The yarn catch insert according to claim 12 wherein a portion of the start-up groove is tapered in a direction around the circumference of the tube and a different portion of the start-up groove widens in the same direction around the circumference of the tube.

17. The yarn catch insert according to claim 12 wherein the first portion of the side surface of the hole and the first portion of the side surface of the yarn catch insert are perpendicular to the longitudinal axis of the tube.

18. The yarn catch insert according to claim 12 wherein the yarn catch insert is comprised of one of plastic, wood, and metal.

19. The yarn catch insert according to claim 12 wherein the yarn catch insert comprises a barb extending beyond the portion of its side surface in a direction toward the portion of the side surface of the hole.

20. The yarn catch insert according to claim 12 having an lower portion and an upper portion, the lower portion having a width corresponding to the width of the hole in the tube, the upper portion have a width less than the width of the hole in the tube, wherein the start-up groove is formed between the side surface of the hole and the upper portion of the yarn catch insert.

21. A yarn catch insert according to claim 14 wherein the outside surface of the yarn catch insert is tapered radially inward adjacent to the start-up groove.

22. A yarn carrier for winding yarn thereon comprising:

a. a tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof, having an outer surface, and having a hole extending around a portion of its circumference; and

b. a yarn catch insert for insertion into the hole formed through the tube, the hole having a side surface with a portion extending circumferentially around a portion of the circumference of the tube, the yarn catch insert having an inside surface, an outside surface, and a side surface, a portion of the side surface positioned opposite the portion of the side surface of the hole when the insert is inserted into the hole to form a start-up groove between the portion of the side surface of the yarn catch insert and the portion of the side surface of the hole, and at least a portion of the start-up groove tapered in a direction along a circumference of the tube..

23. A yarn catch insert adapted to be inserted into a hole formed through a yarn winding tube, the yarn winding tube being a hollow cylindrical tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof and having a substantially cylindrical outer surface, the yarn catch insert comprising:

a. a first member having a first end, a second end opposite the first end, and an inner surface; and

b. a second member having a first end, a second end, and an inner surface facing the inner surface of the first member when the first and second members are positioned in the hole;

wherein start-up groove having a tapered portion is formed between the inner surfaces of the first and second members.

24. The yarn catch insert according to claim 23 wherein the second end of the first member is coupled to the second end of the second member.

25. The yarn catch insert according to claim 23 wherein one of the first and second members has a barb extending beyond its inner surface toward the other member.

26. The yarn catch insert according to claim 23 wherein one of the first and second members has a hook extending beyond its inner surface toward the other member.

27. The yarn catch insert according to claim 23 wherein the inner surfaces of the first and second members are perpendicular to the longitudinal axis of the tube when they are disposed in the hole.

28. The yarn catch insert according to claim 23 wherein the first and second members each have an inside surface and an outside surface, the members comprising a flange extending from their inside surfaces to prevent the yarn catch insert from extending past the outer surface of the tube when positioned within the tube.

29. The yarn catch insert according to claim 23 wherein the start-up groove tapers to a pinch point.

30. The yarn catch insert according to claim 23 wherein a portion of the start-up groove tapers in a first circumferential direction and a different portion of the start-up groove widens in the same direction.

31. The yarn catch insert according to claim 23 further comprising an adhesive applied to an outside surface of at least one of the first and second members.

32. A yarn carrier for winding yarn thereon comprising:

a. a hollow cylindrical yarn winding tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof and having a substantially cylindrical outer surface, the tube having a hole extending from a first end, around a portion of the circumference of the tube to its second end and having a first side surface and an opposite second side surface extending between the first and second ends of the hole;

b. a yarn catch insert according positioned within the hole, the yarn catch insert

comprising:

a first member having a first end, a second end opposite the first end, and an inner surface; and

a second member having a first end, a second end, and an inner surface facing the inner surface of the first member when the first and second members are positioned in the hole;

wherein start-up groove having a tapered portion is formed between the inner surfaces of the first and second members.

33. A yarn carrier for winding yarn thereon comprising:

a hollow cylindrical tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof and having substantially cylindrical inner and outer surfaces, the tube having a non-symmetrical hole formed therein for accepting a yarn catch insert.

34. The yarn carrier according to claim 33 wherein the hole comprises a countersink formed adjacent the inner surface of the tube.

35. The yarn carrier according to claim 33 wherein the hole has a width that tapers in a direction from inside to outside the tube.

36. The yarn carrier according to claim 33 wherein the hole has a bulbous head at one end leading to a longitudinal section that widens as it extends from the bulbous head.

37. A yarn carrier for winding yarn thereon comprising:

a. a hollow cylindrical inner tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof, the inner tube having a substantially cylindrical outer surface and a hole formed through the inner tube along a portion of a circumference of the tube and an inner tube diameter extending to its outer surface,

b. a hollow cylindrical outer tube having a longitudinal axis extending lengthwise between first and second opposite ends thereof and parallel to the longitudinal axis of the inner tube, the outer tube having a substantially

cylindrical inner surface and an outer tube diameter extending to its inner surface that is greater than the inner tube diameter, and a hole formed through the outer tube along a portion of a circumference of the tube,

wherein the inner tube is disposed within the outer tube so that the holes in the inner and outer tubes are substantially aligned.

38. A yarn carrier according to claim 37 wherein the outer surface of the inner tube comprises ribs for securing the outer tube to the inner tube.

39. A yarn carrier according to claim 37 wherein the inner tube comprises plastic, metal, wood, or combinations thereof.

40. A yarn carrier according to claim 37 wherein the outer tube comprises paper.

41. A yarn carrier according to claim 40 wherein the outer tube has a thickness and the composition of the paper varies along the thickness of the outer tube.

42. A yarn carrier according to claim 41 wherein the outer tube has an inside portion and an outside portion and the inside portion is softer than the outside portion.

43. A yarn carrier according to claim 37 wherein the hole of the inner tube has side surfaces that are substantially perpendicular to the longitudinal axis.

44. A yarn carrier for winding yarn thereon comprising:

a. a hollow cylindrical tube having

i) a substantially cylindrical outer surface,

ii) a first end and a second end, the first and second ends positioned opposite one another with the outer surface of the tube therebetween,

iii) an external annular channel adjoining the first tube end, the channel having a base surface radially inward of the outer surface of the tube,

iv) a shoulder formed between the outer surface of the tube and the base surface of the channel, the shoulder extending substantially radially inward from the outer surface of the tube to the base surface of the channel, and

v) a recess in the shoulder extending around a portion of the tube circumference and having an inside surface;

b. a ring adapted to be removably retained within the channel, the ring having

i) an ring engagement surface positioned adjacent to the shoulder when the first ring is retained within the channel, the ring engagement surface having a protrusion coinciding with the recess in the first shoulder, the protrusion having a surface cooperating with the inside surface of the recess to form a tapered groove for engaging the yarn during winding startup, and

ii) a first end surface adjoining the first end of the tube adjacent to the channel.

45. A yarn carrier according to claim 44 wherein one of the base surface and an inside surface of the ring has ribs for removably securing the ring to the tube.

46. A yarn carrier according to claim 44 wherein a score is formed in the outer surface of the tube, the score extending circumferentially around the tube and intersecting the inside surface of the recess.

47. A yarn carrier for winding yarn thereon comprising:

a. an inner hollow cylindrical tube having

i) a substantially cylindrical outer surface,

ii) a first end and a second end, the first and second ends positioned opposite one another with the outer surface of the tube therebetween,

iii) an inner tube diameter extending to the outer surface,

b. a outer hollow cylindrical tube having

i) a substantially cylindrical inner surface,

ii) a first end and a second end, the first and second ends positioned opposite one another with the inner surface of the tube therebetween,

iii) an outer tube diameter extending to the inner surface and greater than the inner tube diameter,

iv) a recess formed in the first end of the outer tube;

c. a ring having a first end surface and a second end surface, the first end surface adjoining the first end of the inner tube, the second end surface having a

protrusion coinciding with the recess in the outer tube.

48. The yarn carrier according to claim 47 wherein the protrusion and the recess coincide to form a tapered start-up groove.

49. The yarn carrier according to claim 47 further comprising a circumferential score in the outer tube aligned with the side surface of the recess.

50. An apparatus for forming a hole in a hollow cylindrical tube, the tube having first and second opposite ends and substantially cylindrical inner and outer surfaces, the apparatus comprising:

a die having an opening formed therein for receiving a punch and having an outer surface that substantially matches the curvature of at least a portion of the inner surface of the tube, the outer surface of the die extending radially outward in the vicinity of and as it approaches the opening in the die to form a lip, whereby when a hole is punched into the tube by placing the die in the tube and then inserting the punch through the tube and into the opening in the die, a countersink is formed on the inner surface of the tube adjacent to the hole formed in the tube.

51. The apparatus according to claim 50 wherein the hole in the die is asymmetrical.